

What is claimed is:

1. A circuit for driving a coil-armature device, comprising:
a first switch configured to selectively activate the circuit;
a pulse width modulation signal generator;
a second switch, responsive to said pulse width modulation signal generator,
that causes a driving voltage source to periodically energize the coil-armature device
according to a duty cycle; and
a means for selectively providing a signal from said pulse width modulation
signal generator to said second switch after a determined time has elapsed after
activation of the circuit.
2. The circuit according to claim 1, wherein said elapsed time period corresponds
to an amount of time required to sufficiently energize the coil-armature device such
that the armature is attracted into a center of the coil.
3. The circuit according to claim 1, wherein said elapsed time period corresponds
to a time required to charge a capacitor from a first charge level to a second charge
level.
4. The circuit according to claim 1, wherein said means for selectively providing
a signal from said pulse width modulation signal generator to said second switch
comprises a NAND gate responsive to a first input signal and said pulse width
modulation signal.

5. The circuit of claim 4, wherein said first input signal to said NAND gate is derived from a voltage level across a capacitor.
6. The circuit according to claim 4, wherein said first input signal has a first voltage level upon activation of said circuit, and wherein said first input signal changes to a second voltage level after said determined time period has elapsed.
7. The circuit according to claim 4, wherein said pulse width modulation generator is configured to alternatively provide a first voltage level that is greater than an upper threshold voltage of said NAND gate and a second voltage level that is less than a lower threshold voltage of said NAND gate.
8. The circuit according to claim 1, wherein said pulse width modulation signal generator comprises:
 - an inverter; and
 - a feed-back loop configured to generate an input signal to said inverter based upon an output signal of said inverter.
9. The circuit according to claim 8, wherein said input signal is dependent upon a voltage drop across a capacitor, said capacitor being periodically charged by said output signal of said inverter.
10. The circuit according to claim 8, wherein said inverter is a NAND gate configured as an inverter.

11. The circuit according to claim 1, further comprising a relay connected between said second switch and said means for selectively providing a signal from said pulse width modulation signal generator to said second switch.

12. The circuit according to claim 1, wherein said second switch is a transistor.

13. A circuit for driving a coil-armature device, comprising:
a first switch configured to selectively activate the circuit; and
a second switch, responsive to a control signal, that causes a driving voltage source to periodically energize the coil-armature device according to one of a first duty cycle and a second duty cycle.

14. The circuit according to claim 13, wherein said second switch is a transistor.

15. The circuit according to claim 13, wherein:
said second switch is configured to periodically energize the coil-armature device according to said first duty cycle for a determined period of time sufficient to move the armature to a center of the coil, and
said second switch is configured to periodically energize the coil-armature device according to said second duty cycle subsequent to said period of time sufficient to move the armature to the center of the coil.

16. The circuit according to claim 13, further comprising a first comparator configured to generate said control signal in response to a comparison between a voltage signal indicative of an amount of energy stored in said coil-armature device and a first reference signal.

17. The circuit of claim 16, wherein said voltage signal indicative of an amount of energy stored in said coil-armature device is generated across a resistor connected in series with the coil-armature device.

18. The circuit of claim 16, wherein:
said first reference signal has a first voltage level during a time period sufficient to move the armature to a center of the coil, and
said first reference signal has a second voltage level subsequent to said time period sufficient to move the armature to the center of the coil.

19. The circuit of claim 16, wherein said first reference signal is generated from a voltage divider circuit.

20. The circuit of claim 19, wherein said voltage divider circuit is adjustable so as to be able to change said first reference signal in response to a circuit mode signal.

21. The circuit of claim 19, wherein said voltage divider comprises a plurality of resistors, and wherein at least one of the resistors is configured to be electrically shorted from said voltage divider in response to a circuit mode signal.

22. The circuit of claim 21, further comprising a second comparator that compares a second input signal to a second reference signal to generate said circuit mode signal.

23. The circuit of claim 22, wherein said second input signal is generated based on a voltage level across a capacitor.

24. The circuit of claim 23, wherein said capacitor is sized so that said second input signal exceeds said second reference signal after a determined time sufficient to move the armature to a center of the coil has elapsed.

25. The circuit of claim 22, wherein said second input signal is configured to exceed said second reference signal after a determined time sufficient to move the armature to a center of the coil has elapsed.

26. The circuit according to claim 16, further comprising a relay positioned between said first comparator and said second switch.

27. A method of selectively energizing an armature-coil device, comprising the steps of:

energizing the coil to a first energy level for a period of time sufficient to retract the armature to a center of the coil; and

energizing the coil to a second energy level subsequent to said time period sufficient to retract the armature to the center of the coil.

28. The method of claim 27, wherein said first energy level is greater than said second energy level.

29. The method of claim 27, wherein:

said first energy level is generated by connecting a driving voltage to the coil for a continuous amount of time; and

said second energy level is generated by alternatively connecting and disconnecting said driving voltage to the coil according to a duty cycle.

30. The method of claim 27, wherein said driving voltage is alternatively connected and disconnected from said driving voltage by a switch that is alternatively turned on and turned off in response to a control signal.

31. The method of claim 30, wherein said control signal is a pulse-width modulated signal.

32. The method of claim 27, wherein:

said first energy level is generated by alternatively connecting and disconnecting a driving voltage to the coil according to a first duty cycle; and

said second energy level is generated by alternatively connecting and disconnecting said driving voltage to the coil according to a second duty cycle.

33. The method of claim 32, wherein said first duty cycle and said second duty cycle are determined based upon a comparison of a first reference signal to a signal indicative of an amount of energy stored in the coil.

34. The method of claim 33, wherein:

said first reference signal has a first value during said period of time sufficient to retract the armature to the center of the coil; and

said first reference signal has a second value subsequent to said period of time sufficient to retract the armature to the center of the coil.